DESIGN OF STAND ALONE SOLAR SYSTEM WITH CONSIDERATION OF WIND SPEED FACTOR FOR REMOTE AREA

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"My dearest mum, family, Dr Jasrul and friends"

This is for all of you

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ABSTRACT

Utilization of Stand-alone Solar PV system or Off-grid Solar PV system is one of the availability approaches that can provide the electricity to a rural or remote area which is far away from the national electricity grid or enable to be reach. Theoretically, the successful application of Stand-alone Solar system reached the electricity demand while improving the living condition of local people at that place. The design of Stand-alone Solar system is much complicated compared to the Grid-connected Solar PV system where the design have to design properly with consideration of many factors. For design this system, the energy demand, irradiation to load ratio, system voltage, total load current, day of autonomy, depth of discharge of battery, ambient temperature with temperature correction factor, the limit of parallels stings of batteries factor have to seriously take into account to designing the size of capacity of the battery bank. In designing the sizing of PV array, the temperature derating factor, nominal operating cell temperature (NOCT), dirt factor, over-supply coefficient, coulombic efficiency, peak sun hours, and maximum solar irradiance is very important factors to design the sizing of PV array. These factors are covered in system sizing of design. The purpose of these consideration is to ensure the designed system will operate under design potential without any failure when worse case condition happen at some days and also to maximize the lifetime of the system. The economic analysis of Stand-alone Solar system also be covered to analyze the startup cost and the return of investment. The different between using calculation analysis and using HOMER software while designing the stand-alone solar system also being discussed in this paper.

ABSTRAK

Penggunaan sistem Stand-alone Solar PV atau sistem Off-grid Solar PV adalah satu daripada pendekatan yang berkeupayaan menyediakan sumber elektrik di kawasan luar bandar atau pendalaman yang jauh daripada grid elektrik negara atau tidak langsung dapat mencapai grid elektrik tersebut. Penggunaan system ini dapat memenuhi keperluan tenaga elektrik kepada penduduk di kawasan tersebut disamping meningkatkan lagi taraf kehidupan dengan adanya tenaga elektrik. Reka bentuk sistem Stand-alone Solar PV adalah lebih rumit berbanding sistem Grid-connected Solar PV di mana reka bentuk untuk sistem ini perlulah di reka bentuk dengan amat teliti dengan mangambil kira banyak faktor. Untuk merekabentuk sistem ini, antara faktor yang perlu diambil kira adalah permintaan tenaga, kadar irradiation terhadap beban, sistem voltan, jumlah arus beban, hari autonomi, kedalaman discharge bateri, suhu persekitaran dengan mengambil kira faktor pembetulan suhu, dan had penyambungan bateri disambung secara selari untuk menyira jumlah kapasiti bank bateri. Manakala, Untuk mengira saiz PV array, faktor seperti nyahkadaran suhu, nominal suhu PV sel beroperasi (NOCT), faktor kekotoran, lebihan bekalan, kecekapan coulombic, waktu kemuncak matahari, dan maksimum irradiance solar adalah fator yang amat penting untuk menentukan saiz PV array. Kebiasaanya, faktor-faktor ini digunakan dalam reka bentuk sistem saiz dan ianya amat penting untuk memastikan reka bentuk sistem beroperasi dibawah potensi reka bentuk tanpa sebarang masalah apabila berlaku satu keadaan yang tidak dijangkakan pada beberapa hari. Ia juga amat penting untuk memaksimakan jangka hayat sistem tersebut. Analisa ekonomik untuk sistem ini juga dilakukan unutk menganalisa kos permulaan sistem dan juga pemulangan hasil pelaburan. Perbezaan menggunakan analisis secara pengiraan dan juga menggunakan system HOMER dalam merekabentuk system Stand-alone Solar PV juga dibincangkan didalam kertas ini.

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CHAPTER 1

INTRODUCTION

1.1 Overview

In Malaysia, the demand of electrical power is increasingly day by day in order to fulfill the daily demand from the loads. However, there is a problem for specific area especially in rural places which normally have a lack of electricity because of difficulty to reach to the national electric grid. Due to improvise and to overcome this problem, renewable energy is one of the best solution because this is the type of energy that comes from the natural energy which is the sunlight. By using renewable energy, it will give an extra advantage to the load since they will not exhaust unlike the conventional energy. Due to that, in order to convert the sunlight energy to a useful energy, some device with a specific system is required. The device that normally used for energy conversion is photovoltaic (PV) module. PV module is assembled with PV cells that know as solar cells. The installation of photovoltaic typically involve an array of photovoltaic panels or module, batteries, interconnection wiring and the type of inverter [1-2].

In addition, there are many design and application process for solar system. One of the best design that able to be installed in rural area is Stand-alone solar system. However, the design of Stand-alone solar system is complex because it will be operated without connected to the main electric's grid. On the other hand, the system needs to be design properly to ensure the system is operated with high efficiency and to reduce any

troubles during its application even though the system have a highest startup and cost of maintenance. The followed section of this paper will discussed a lots of factors that need to be considered during designing the system. The load calculation in order to determine the lowest of life cycle cost of the system and also the return of investment of the system are also discussed in this paper.

1.2 Problem Statement

Since the demand of electricity in rural area is increasingly day by day, the interest toward renewable energy also grown constantly in order to produce the electricity. Renewable energy become most popular nowadays since the energy will not exhaust unlike conventional energy form. One of the best system that will be selected for conversion energy is solar Photovoltaic. Stand-alone solar system and Grid connected solar system are two types of Photovoltaic system that normally used in Malaysia.

In order to design Stand-alone solar system, designer need to consider many important aspect because the system is more complex compared to the Grid connected Solar System. The designing system need to design properly to ensure the system operated without failed and the system able to operate with high efficiency. On the other hand, the economics analysis of the designing system must be done by designer in order to determine the cost of system from start-up the system until the maintenance cost of the system.

1.3 Objective

The objective of this project was focused clearly to design a simple Stand-alone solar system for rural areas based on a lot of factors in order to ensure the system operate successfully and to determine the economic analysis in order to know the lowest of life

cycle cost of the system and also the return of investment of designing Stand-alone solar system.

1.4 Scope of Work

Scope of this work involved

1. The analysis of Stand-alone solar system for remote area and their economic analysis starting from start-up the system until the maintenance cost of the system.
2. The design of Stand-alone solar system with consideration a lot of important factor to ensure the designing system is operated on design potential since the design is more complex compare to Grid-connected solar system
3. The economic analysis involve the cost of installation, life of cycle cost, the payback period and maintenance cost of the system.

1.5 Project Report Layout

This paper are divided into 5 chapters. Chapter 1 gives an introduction about the project which give a briefly explanation about the renewable energy and the selected design have been choose based on the case study. The background, problem statement of the project, objectives, scope of project and report outlines are included in this chapter.

Chapter 2 consist the overview of the project that has been done. This chapter included the information of Stand-alone solar system design and the basic information for economic analysis of the system. Meanwhile the equipment that have been used is stated at the end of this chapter.

Chapter 3 gives the methodology of this research. Readers can have a clear view on how the Stand-alone solar system and economic analysis of the designing system can be done. The calculation procedure and all the equation that will be used in the designing system is stated precisely.

Chapter 4 described the obtained results of designing system such as the sizing of the PV system with their economic analysis which referred from the equation that have been stated in Chapter 3.

Chapter 5 gives conclusion and recommendation of this project. The knowledge obtained from this project and the usefulness of this project is concluded. The weakness of this project is suggested in the recommendation to enable improvement to be done.

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